G4500/3500 Series BLACKBOX Portable

Quick Reference Guide

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I Introduction

Overview

Dedicated Tablet PC

G4500 BLACKBOX Portable

The ELSPEC G4500/3500 SERIES BLACKBOX Portable high-definition Power Quality meter delivers superior accuracy and analysis features for advanced power quality surveys by recording all parameters all the time.

Powered by revolutionary PQZip compression technology, the G4500/3500 SERIES BLACKBOX Portable is capable of recording up to 1000 times more information than competitive instruments with equivalent memory sizes. The complimentary PQSCADA software package provides an innovative and convenient way of performing the most complicated power quality investigations

A State of the Art PQSCADA Investigator application helps to explore power quality events, zooming in and out on any parameter at High Definition resolution, from months to microseconds in mouse-click speed and simplicity.

The Embedded Website is the user interface to the unit. Real time parameters can be viewed and the unit configuration can be performed using the website. The optional dedicated Tablet PC enables configuring, analyzing, and displays all monitored real time values of the device.

This document is a Quick Reference Guide intended to provide a quick and easy reference for the setup up, configuration, and use of the BLACKBOX device. For a more detailed reference document, please refer to the G4500 User Guide on the BLACKBOX CD included with each device.

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Functionality, Features, and Ease of Use

- **Superior Accuracy:** Elspec's unique measurement method uses *dual range gain* of 2 x 16 bit to yield superior accuracy exceeding IEC 61000-4-30 Class A requirements and therefore captures the finest Power Quality parameter details and differences.
- **Threshold Free Setup:** Continuous unlimited onboard recording of all parameters at the highest sampling rate of 1024/512 samples per cycle, therefore there is no need to worry about missed events due to incorrect setup.
- **PQZIP Compression Technology:** The unique patented **PQZIP** compression technology enables you to store up to 1000 times more information than typical file formats. This allows storage of complete and precise data for extended periods of time.
- **Continuous Recording of all Parameters:** The BLACBOX's unique continuous recording feature allows you to identify, not just the failure, but the condition(s) that lead to the failure.
- **Post Processing:** Elspec's Power Quality Investigator software allows for powerful, but simple to use, Post processing and report generation.
- **Highest Sampling Rate:** The G4500/3500 SERIES Portable samples all channels simultaneously at the highest sampling rate of 1024/512 samples per cycle for voltage and 256 for Current, without the need to set any thresholds or triggers.
- **SCADA Compatible:** The G4500/3500 SERIES is equipped with standard Industrial protocols for seamless integration with SCADA systems.
- **Long Life Battery:** The portable contains a lithium battery that will provide up to 2 hours of fully functional operation without an external AC/DC power source.
- **Standard Compliance Testing:** The BLACKBOX Portable provides PQ parameters according to EN50160 and IEC 61000-4-15 as well as other National Standards. Custom Standards can be modified per customer request.
- **Integrated I/O & Compression:** The device contains integrated I/O GPS options, Digital Inputs, Relays, and Temperature input.
- **Plug and Play:** Automatic setup with self identifying probes.

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Product Features

Product Feature Chart	G3500	G4500
Real-time Measurements		
Voltage/current: per phase, average, unbalance	✓	✓
Power: real, reactive, apparent, power factor, frequency	✓	✓
Energy: bi-directional, total, import, export, net	✓	✓
Demand: block, rolling block, thermal, predicted	✓	✓
Sampling rate, maximum samples/cycle	**512**	**1024**
Harmonics (individual, even, odd, total) up to	**255th**	**511th**
Measurement according to IEC 61000-4-30	✓	✓
Cycle by Cycle RMS, Frequency and Harmonics	✓	✓
Measurement during overloading (from nominal)	**X10**	**X10**
Battery Backup	**2 Hours**	**2 Hours**
Type of Analog to Digital converter	**16/20* bit**	**16/20* bit**
Data and Waveforms Logs		
Cycle-by-cycle PQZIP logging	✓	✓
Event logs	✓	✓
Waveform logs	✓	✓
Min/max logs for any parameter	✓	✓
Timestamps, resolution in micro seconds		
Time SYNC accuracy via LAN (Fast Ethernet Link) or via GPS + PPS	**50-100 µs**	**50-100 µs**
Storage Capacity		
Internal Memory	**2 GB**	**32 GB**
Recording Time (depending on selected resolution)	**3 Months**	**Unlimited**
Power Quality Analysis		
Sag/swell monitoring	✓	✓
Symmetrical Components: zero, negative, and positive	✓	✓
Transient detection, microseconds (50Hz/60Hz)	**39/32.5 µs**	**19.5/16µs**
Flicker (IEC 61000-4-15)	✓	✓
Fast Flickering	✓	✓
Compliance testing to EN50160	✓	✓
EN50160 Timestamps	✓	✓
Configurable for IEEE 519-1992, IEEE 1159, SEMI	✓	✓
Time stamps of above	✓	✓
Inter-harmonics	✓	✓

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Product Feature Chart			G3500	G4500
Communication Ports and I/O				
Digital Inputs			4	4
OPC Gateway: other RS-485/422 accessible via OPC			✓	✓
Ethernet Ports			1	3
Onboard DNP3 Protocol			✓	✓
Modbus/TCP			✓	✓
Modbus/RTU			✓	✓
Power Over Ethernet (PoE)- Out			✓	✓
RS232 port RS-485/422 port			✓	✓
Onboard Comprehensive Web Server			✓	✓
Onboard OPC (Open Connectivity) Server			✓	✓
Wi-Fi Communications (802.11g)			N/A	✓
PCMCIA Extension Slot			N/A	✓
External Temperature Sensor Socket			✓	✓
Parameter	**Uncertainty**	**Measuring Range**		
Frequency	±10 mHz	42.5 Hz – 69 Hz	✓	✓
Magnitude of Supply Voltage	±0.1% of Udin	10% – 150% of Udin	✓	✓
Flicker	±5% of reading	0.2 – 10 Pst	✓	✓
Supply Voltage Dips and Swells	Magnitude: ±0.2% of Udin Duration: ±1 cycle	N/A	✓	✓
Voltage Interruptions	Duration: ±1 cycle	N/A	✓	✓
Unbalance	±0.15%	0.5% – 5% u2 0.5% – 5% u0	✓	✓
Harmonics	IEC 61000-4-7 Class I	10% – 200% of Class 3 of IEC 61000-2-4	✓	✓
Interharmonics	IEC 61000-4-7 Class I	10% – 200% of Class 3 of IEC 61000-2-4	✓	✓
Under-Deviation and Over-Deviation	±0.1% of Udin	10% – 150% of Udin	✓	✓
Standard IEC 61000-4-30 Class A Compliance	• Aggregations • Time Clock Uncertainty • Flagging • Transient Influence Quantities		✓	✓

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II Before Getting Started

Safety Information

To avoid electrical shock or fire:

- Review the entire manual before using the instrument and its accessories and observe all warnings and cautions.
- Avoid working alone.
- Do not operate the Instrument around explosive gas or vapor.
- Use only insulated current and voltage probes.
- Before use, inspect the instrument, voltage, current probes, leads and accessories for mechanical damage, and replace when damaged. Pay special attention to the insulation surrounding the connectors and plugs.
- Remove all probes, test leads, and accessories that are not in use.
- Make sure the instrument is properly grounded through the power cord to protective earth ground.
- Do not apply input voltages above the rating of the instrument as shown on the name plate.
- Do not insert metal objects into connectors and openings.
- Never open instrument's enclosure during operation; dangerous voltages are present.
- Use the instrument only as specified in this manual, or the protection provided by the instrument may be impaired.
- Do not expose the instrument to extreme moisture and or rain.
- Do not operate the instrument or its accessories when found wet for any reason.

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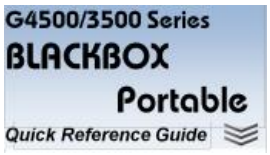
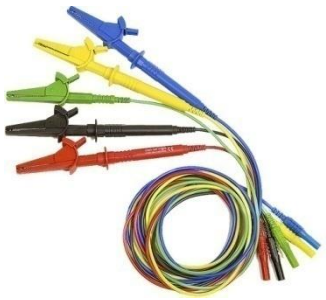
Standard Accessories

Part Number	Description	Illustration
SPG-4500-0190 **SPG-3500-0190**	G4500(shown) or G3500 BLACKBOX Unit	
MEB-2999-0000	Trolley Carrying Case	
SOF-4000-0001	Elspec BLACKBOX Software Installation CD	
SMR-3011-0110	Quick Reference Guide	
EAH-4303-5100	Black AC Voltage Cord with Crocodile Clip + Fuse (**3**M)	
EAH-4303-5200	Red AC Voltage Cord with Crocodile Clip + Fuse (3M)	
EAH-4303-5300	Blue AC Voltage Cord with Crocodile Clip + Fuse(3M)	
EAH-4303-5400	Yellow AC Voltage Cord with Crocodile Clip + Fuse(3M)	
EAH-4303-9500	Green AC Voltage Cord with Crocodile Clip(3M)	
EAH-4303-5100	Black DC Voltage Cord with Crocodile Clip + Fuse (3M)	
EAH-4303-5200	Red DC Voltage Cord with Crocodile Clip + Fuse (3M)	

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ENT-1002-0190	48VDC terminal block connector (RoHS Compliant)	
ENT-1002-0191	Temperature sensor terminal block connector PT100 type (RoHS Compliant)	
ENT-1004-0190	RS485/422 Communication terminal block connector (RoHS Compliant)	
ENT-2008-0190	Multi IO terminal block connector (RoHS Compliant)	
ENT-1003-0190	Relay terminal block connector (RoHS Compliant)	
TOE-0010-0013	LAN communication cord length: 2M	
EPC-2012-2190*	Power Cable for Cont. Europe 10A/125V, straight, 1.8M, Black	
EPC-7012-2190*	Power Cable for North America 10A/125V, straight, 1.8M, Black	
SOA-9045-3001**	3000 Amp Flexible Current Clamp (Set of 4)	

* **Only one power cord is included and will depend on the region to which the shipment is made.**

** **Other Measurement clamps are available to be ordered separately. Please refer to the G4500 Portable User Manual or the price list.**

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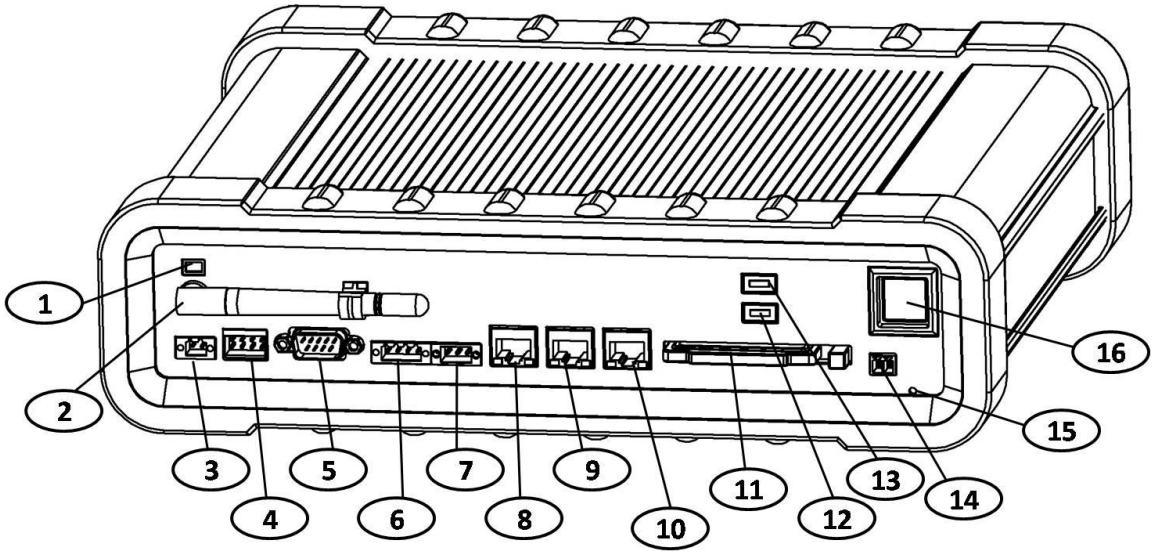
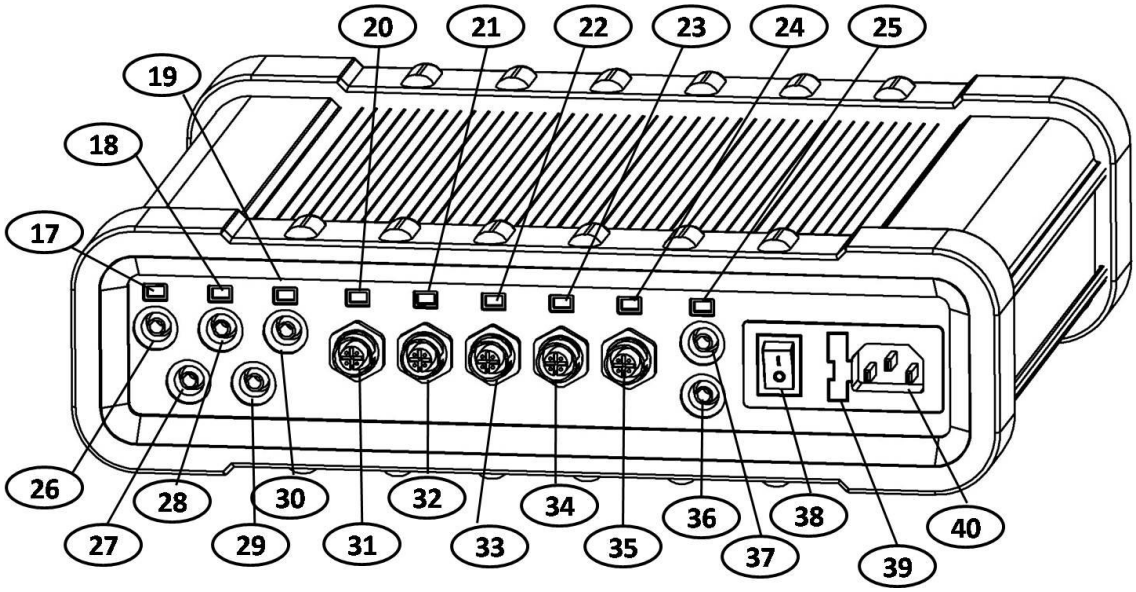
Controls and Indicators

Front Panel



Rear Panel



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Reference

#	Description	Comments
1	Wi-Fi activity indicator	Available only in the G4500
2	Wi-Fi antenna	Available only in the G4500
3	Auxiliary power supply socket	
4	Digital/Irig B Input socket	
5	RS232 communication socket	
6	RS485/422 communication socket	
7	Relay	
8	WAN – 10/100Mb RJ45 Ethernet socket	Available only in the G4500
9	LAN1 – 10/100Mb RJ45 Ethernet socket	Available only in the G4500
10	LAN2/LCD – 10/100Mb RJ45 Ethernet socket	
11	PCMCIA Extension slot	Available only in the G4500
12	Battery status indicator	
13	Operational status indicator	
14	External temperature sensor socket	
15	Reset to “factory defaults” button	
16	Operation ON/OFF switch with indicator	
17	L1 voltage “presence” indicator	
18	L2 voltage “presence” indicator	
19	L3 voltage “presence” indicator	
20	I1/L1 current probe detection indicator	
21	I2/L2 current probe detection indicator	
22	I3/L3 current probe detection indicator	

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#	Description	Comments
23	I4/Neutral current probe detection indicator	
24	IDC/Earth probe detection indicator	
25	VDC “presence” indicator	Available only in the G4500
26	L1 voltage sensor socket	
27	Neutral voltage sensor socket	
28	L2 voltage sensor socket	
29	Earth/Ground reference socket	
30	L3 voltage sensor socket	
31	I1/L1 current probe socket	
32	I2/L2 current probe socket	
33	I3/L3 current probe socket	
34	I4/Neutral current probe socket	
35	IDC/Earth current probe socket	Available only in the G4500
36	VDC (minus) probe socket	Available only in the G4500
37	VDC (plus) probe socket	Available only in the G4500
38	Main Power supply ON/OFF Switch	
39	Fuse holder	
40	Main Power Supply inlet socket	

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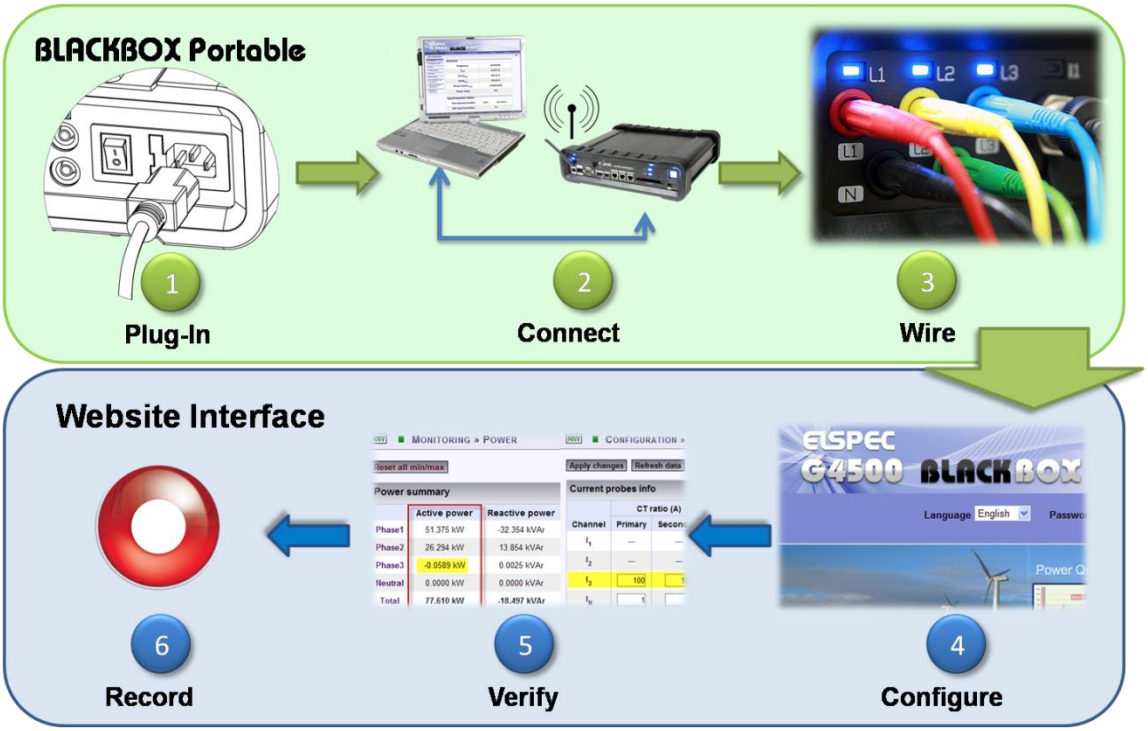
III On Site Setup

The **On Site Setup** chapter is a simple step by step procedure for the setup of the BLACKBOX Portable device on site. After the initial setup and configuration, the **Downloading and Analyzing Recorded Data on page IV—1** provides detailed explanations of how to work with the powerful, yet simple, PQSCADA and Investigator software applications.



1. **Connect the AC Power Supply**
1. **Establish a Connection with the Unit**
3. **Wire the Voltage and Current Measurement Inputs**
4. **Configure the Unit**
5. **Verify the Measurement Readings**
6. **Start/Stop PQZip Recording**

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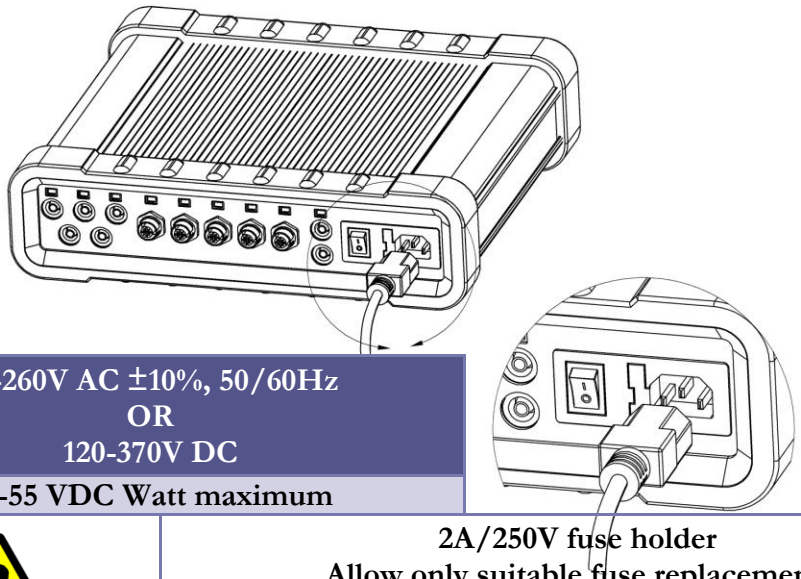
Step 1: Connect the AC Power Supply



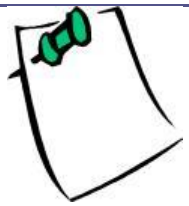
85-260V AC ±10%, 50/60Hz OR 120-370V DC
35-55 VDC Watt maximum

⚠	2A/250V fuse holder Allow only suitable fuse replacement! Make sure the Instrument is properly grounded through the power cord to protective earth ground.

To connect the AC power supply:

1. Connect the female end of the **Power Cable** to the **Main Power Supply inlet socket (40)** of the unit.
2. Connect the male plug end of the **Power Cable** to the electrical supply outlet.
3. Turn the **Main Power Supply On/Off switch (36)** to the **On** position.
4. Press the **Operation ON/OFF switch with indicator (16)**.
5. Verify the unit is running on AC Power using the status indicator lights (as below).

Status	State
Flashing blue	Main or auxiliary power applied, Battery charging
Solid blue	Main or auxiliary power applied, Battery fully charged
Red	No main or auxiliary power available, Powered by internal battery



The unit can run on battery power for up to two hours
Also, the device can be powered using the Auxiliary DC Voltage Supply, please refer to the BLACKBOX User Guide for more details.

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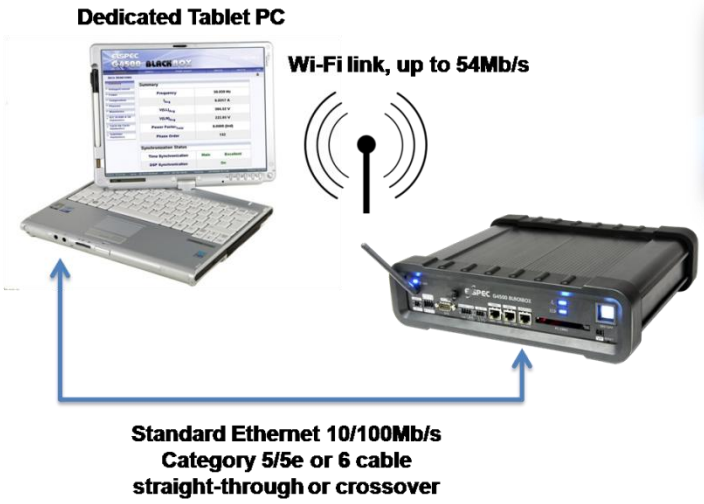
Step 2: Establish a Connection with the Unit



Wired or Wireless Single PC Connection

The most convenient way to connect a Dedicated Tablet or any other PC is by using a Wi-Fi or wired Ethernet link. It is best to make only one connection type at time, and when a wired connection is used, disconnect or disable the wireless link.

Technically, any of the available Ethernet ports can be used for a single PC connection. However, the most recommended is a LAN1 option (as shown above) because of the integrated DHCP server available thru that port. When connected, a PC will automatically obtain an IP address configuration which allows a seamless connection to the BLACKBOX Portable's internal WEB/FTP servers as well as to a router management WEB server.

Integrated Router

The G4500 BLACKBOX Portable (not available on the G3500) contains an integrated IEEE 802.11g/b router preconfigured as an industry standard access point. This is to provide the most convenient and simplest connectivity with the Dedicated Tablet PC.

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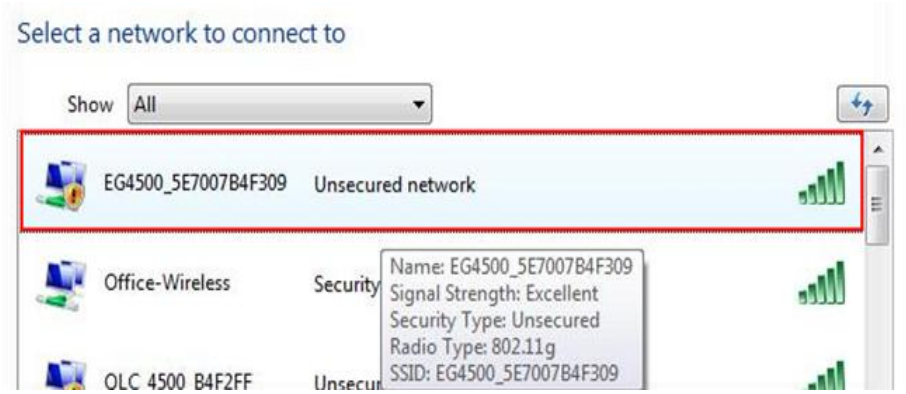
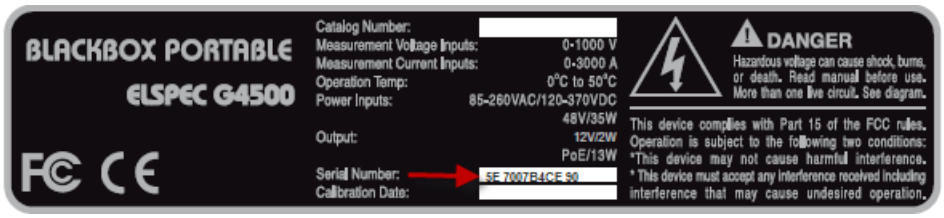
Wi-Fi Access Point



You may select the device according to the serial number. Eg: EG4500_ [*device serial number*]. The device serial number is located on the name plate as shown below.



The Wi-Fi link is active when a Wi-Fi activity indicator light is flashing or solid blue.

There are alternative connection options available. For more details, please refer to the G4500 BLACKBOX User Guide.

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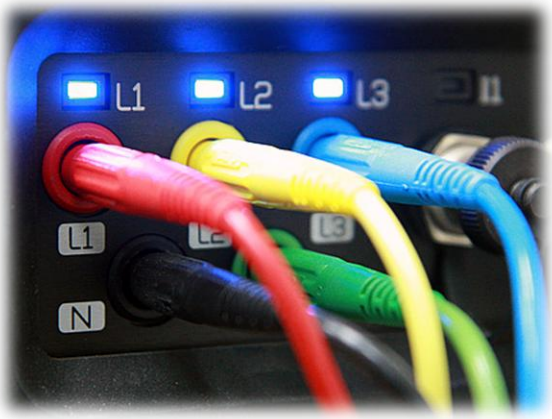
Step 3: Wire the Voltage and Current Measurement Inputs

Connect Voltage Cords

The BLACKBOX Portable provides 4 fast sampling AC Voltage Sensor Sockets and a VDC Probe Socket



To attach the AC Voltage Cords:

1. Attach voltage cords to the **Voltage Sensor Sockets** on the device according to the color codes.
2. Attach Crocodile clips from the voltage cords to the measured power source.
3. Verify connection with the **Presence- Indication LEDs** as above. The LED light illuminates in blue for voltage levels above 10% of the nominal value.

Make sure that the voltage measurement ground is connected first, then neutral, and finally the phases.

Refer ***Circuit Topologies on page V—1*** ***in order to interface the device with your circuit topology.***

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Attach Current Clamps

The BLACKBOX Portable provides 4 AC and 1 AC/DC Current Probe Sockets.

The AC Current Probe Sockets are marked as **I1-I4**.

To attach Current Clamps:

1. Connect each current phase clamp (neutral if applicable) to its corresponding Current Probe Socket.
2. Connect the measurement end of current clamp to the measured power source.

The current clamps are calibrated from the factory for a specific phase. Please make sure that you pay attention to the phase connections.

The current clamps convert current to low voltage.

Refer to ***Circuit Topologies on page V—1*** ***to interface the device with your circuit topology.***

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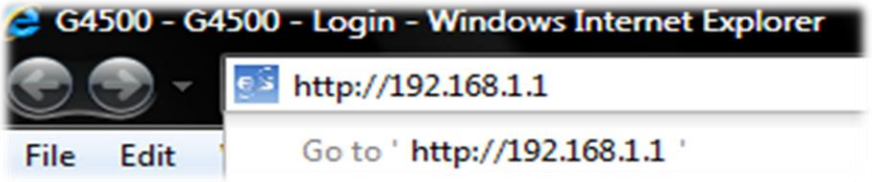
Step 4: Configure the Unit

Before any measurements are taken with the device, some basic configurations in the Web Interface are required.

Login to the Internal Website

When a wireless Ethernet connection is established, the internal Website can be accessed by simply typing the device IP address into the address field on a WEB browser application (G4500 default factory **IP 192.168.1.1,** G3500 default factory **IP 169.254.249.247**)



When the device IP address is unknown, use the Elspec Search utility to discover it. Please refer to the G4500 BLACKBOX User Guide for details on using Elspec Search to locate the unit.

- Login as **Administrator (Password: 12345)** in order to set configuration options.

The Website is optimized to work with Microsoft© Explorer 7. Other web browser applications can limit some functionality and/or show an incorrect layout.

If you need to change the default IP address or have any difficulties connecting to the unit, please refer to the G4500 BLACKBOX User Guide for more details.

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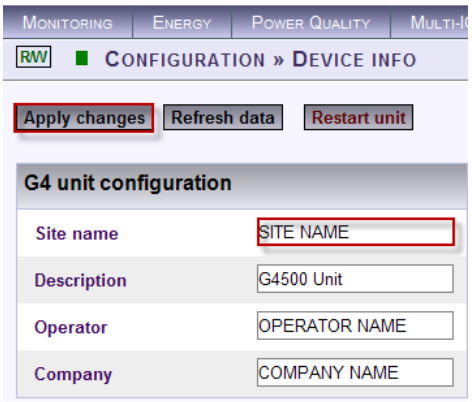
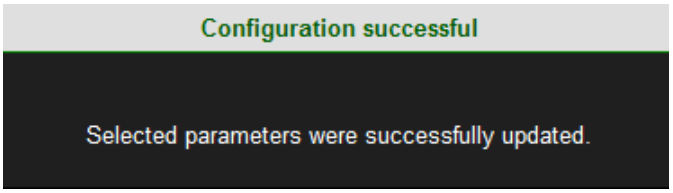
Unit Setup



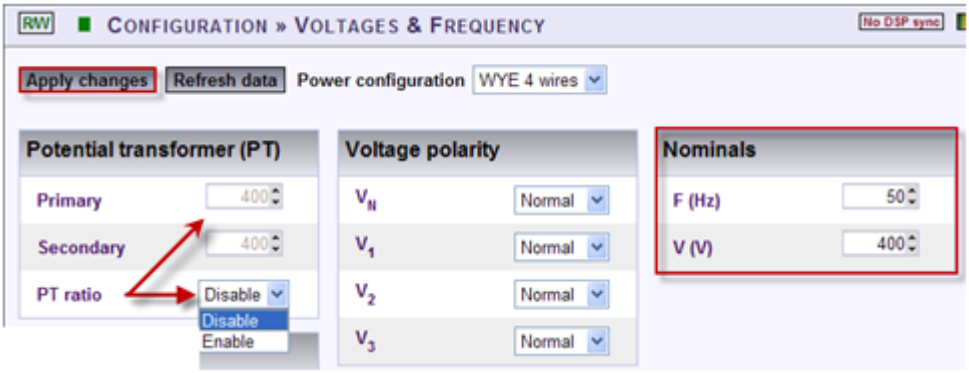
- From **Configuration→Device Info, enter the <Site Name>**, then click **Apply Changes**.

You may also enter the description, Operator, and Company; however it is not required at this time.

A confirmation window appears:



Voltage and Frequency



- From **Configuration→Voltages & Frequency,** enter the correct nominal values for Voltage and Frequency, then click **Apply Changes**.
- If measuring to PTs, then enable the **PT ratio** and set **Primary** and **Secondary** values

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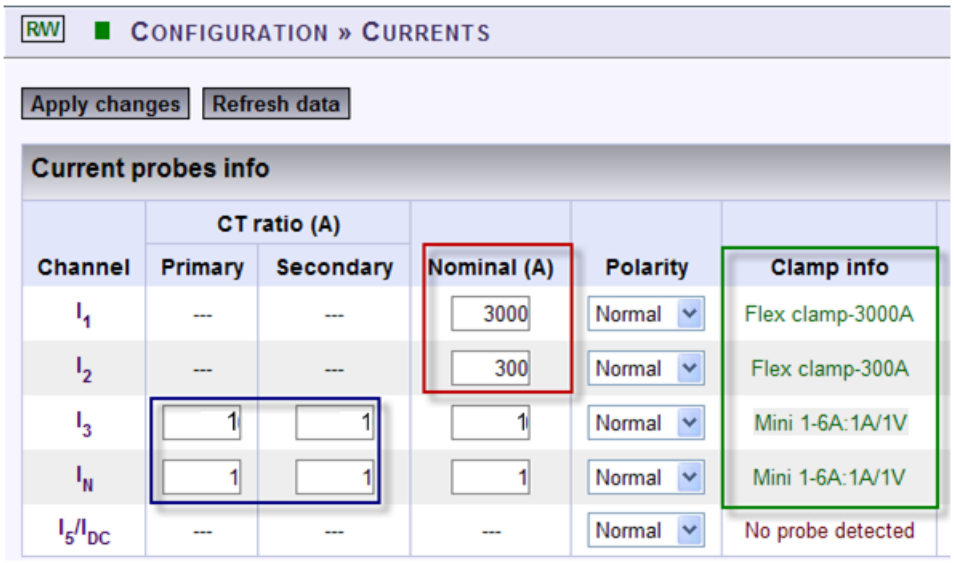
Currents



- From **Configuration→Currents,** enter the correct current nominals, then click **Apply Changes**.

If measuring using CT's, then verify/set the CT Primary and Secondary ratios.

If measuring with mini clamps, please verify the Primary and Secondary ratios as well as the Clamp info for accuracy.

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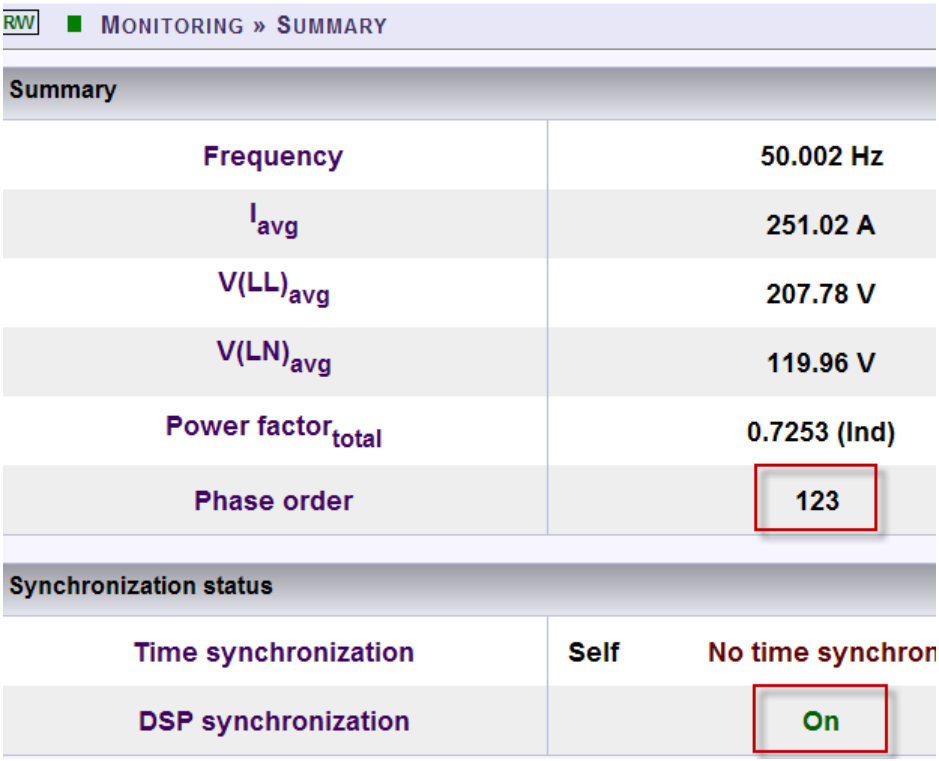
Step 5: Verify the Measurement Readings

In order to ensure the correct measurement readings of the device, we strongly recommend that you verify the voltage and current measurements, as well as, the phase direction of the current clamps.

Summary



- From the **Monitoring→ Summary**, Verify the **DSP Synchronization** is **On** and the Phase order is **123**.

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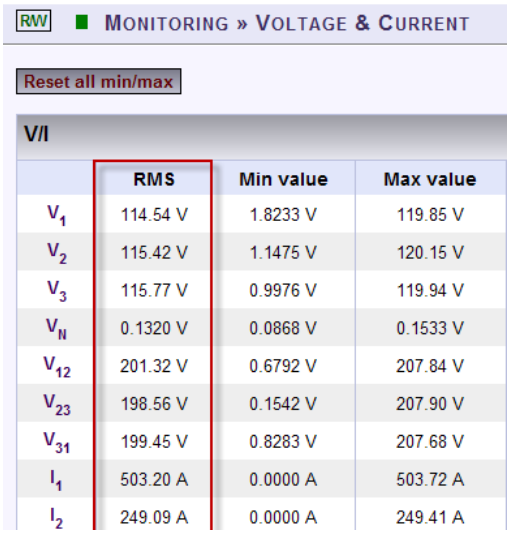
Voltage & Current

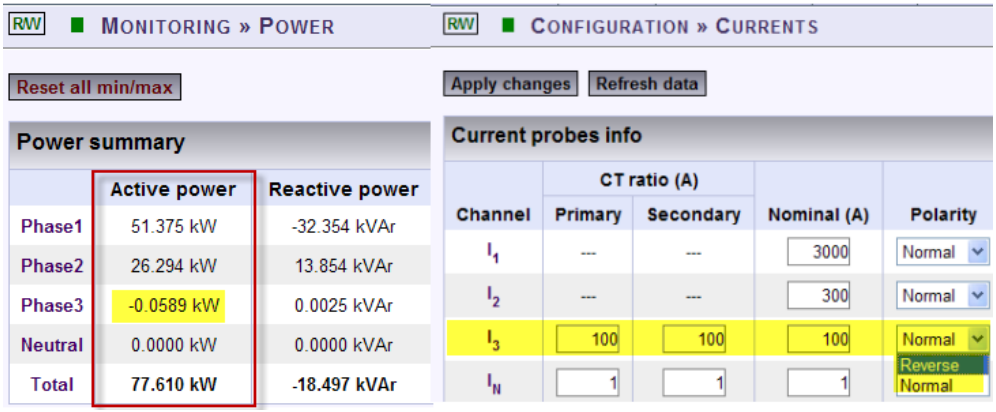


	RMS	Min value	Max value
V_1	114.54 V	1.8233 V	119.85 V
V_2	115.42 V	1.1475 V	120.15 V
V_3	115.77 V	0.9976 V	119.94 V
V_N	0.1320 V	0.0868 V	0.1533 V
V_{12}	201.32 V	0.6792 V	207.84 V
V_{23}	198.56 V	0.1542 V	207.90 V
V_{31}	199.45 V	0.8283 V	207.68 V
I_1	503.20 A	0.0000 A	503.72 A
I_2	249.09 A	0.0000 A	249.41 A

- From **Monitoring→Voltage & Current**, verify RMS values for both voltage and current are the expected values.

If incorrect, check the PT/CT ratios as well as the connection of the voltage and current probes to the device and the power source.

Monitoring/Power



	Active power	Reactive power
Phase1	51.375 kW	-32.354 kVAr
Phase2	26.294 kW	13.854 kVAr
Phase3	-0.0589 kW	0.0025 kVAr
Neutral	0.0000 kW	0.0000 kVAr
Total	77.610 kW	-18.497 kVAr

Channel	CT ratio (A) Primary	CT ratio (A) Secondary	Nominal (A)	Polarity
I_1	---	---	3000	Normal
I_2	---	---	300	Normal
I_3	100	100	100	Normal
I_N	1	1	1	Reverse / Normal

- From **Monitoring→Power,** verify the Active power readings are positive integers.

If the active power reading in any phase is negative (yellow highlight), then change the relevant phase from Normal to Reverse in **Configuration→Currents** or reverse the polarity of the current clamp at the power source by changing the direction.

Generators commonly display a negative Active power value.

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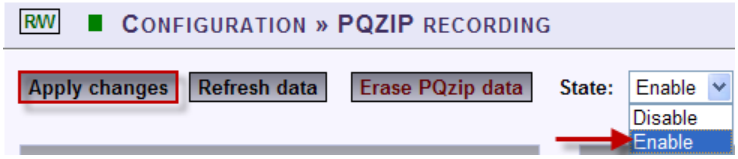
Step 6: Start/Stop PQZIP Recording

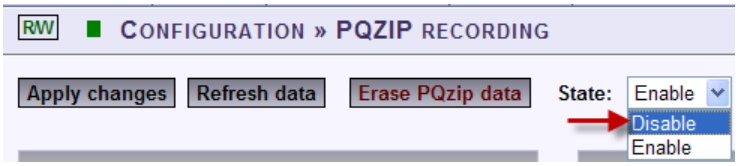
In order to record actual data for further analysis by PQSCADA and Investigator, you must first enable the PQZIP recording.



To enable PQZIP Recording:

1. From **Configuration→PQZIP Recording**, select **Enable,** then click **Apply Changes**.
2. It is recommended to record the starting/ending time and date of each measurement set. This helps to locate individual measurement sets at a later date.
3. After all data measurements have been taken, then you need to stop the PQZIP recording (Disable PQZIP).

To Disable PQZIP Recording:



From **Configuration→PQZIP Recording**, select **Disable**, then click **Apply Changes.**

We strongly recommend that you verify the system time for accuracy before recording any data.

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IV Downloading and Analyzing Recorded Data

This section of the Quick start Guide describes how to begin working with PQSCADA and Investigator software to review and analyze data in recorded data files. Use it to become familiar with the PQSCADA and Investigator interface and features. The BLACKBOX CD enclosed contains all of the required software in an easy to use Auto-Run format.

PQSCADA/Investigator Key Features & Benefits

- **Auto reports generation:** Automatic reports are generated through the pre-defined Tasks functions that allow you to set regularly scheduled exports – COMTRADE, PQDIF, and/or reports – PDF, EXCEL, HTML according to a specified event or time trigger (monthly, daily, weekly, and fixed).
- **Automatic Notification**: Three possible notification possibilities: email, SMS, and Pop-Ups. The notification is triggered by events by pre-defined or user defined electrical events.
- **Analyze the data:** Using a series of views to see different aspects of it, including summaries, trends, spectral of Volt/Amps/Hz, events, harmonics, THD, Flicker, power and energy.
- **Multiple device synchronization:** Elspec's Investigator allows you to view multiple devices synchronized in time. You can adjust the data shown by turning on and off display of different devices and select other parameters. You can focus on the specifics that help you analyze and understand the power quality data.
- **Generate reports**: the Investigator software application builds reports based on EN 50160 and other specific national standards. Additional standards templates can be modified upon request.
- **Organized Data**: by establishing a Node/Site all devices are mapped on the tree structure for easy navigation and orientation of the recorded data.

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Download Recorded Data with PQSCADA

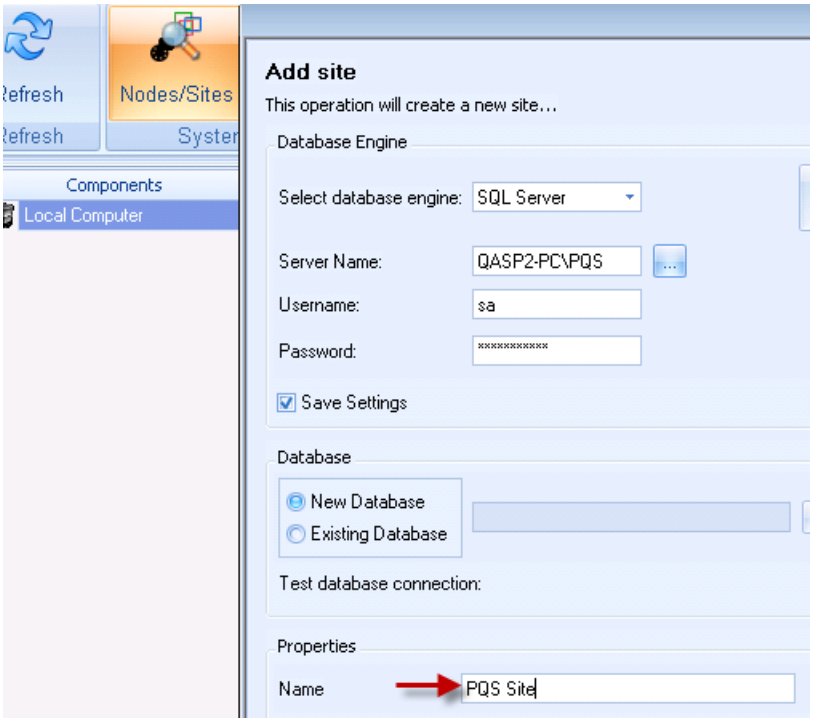
Establish a connection between the device and the PQSCADA in order to import and view the measurement data. The following steps assume that you have PQSCADA and Investigator installed on your PC.

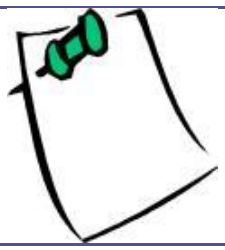
Building a Site Structure

The purpose of a *Site* is to organize the *Nodes* by a common set of characteristics (i.e. location).

To add a Site:

1. Double click the **PQSCADA** icon on your desktop to start.
2. From the **Nodes/Sites** tab, right click **Local Computer** or **selected site**, then select **Add Site**
3. Enter configuration values in the **Add Site** window. (in our example, we assigned **PQS Site** as the new site name)





For more details, please refer to the PQSCADA User Manual.

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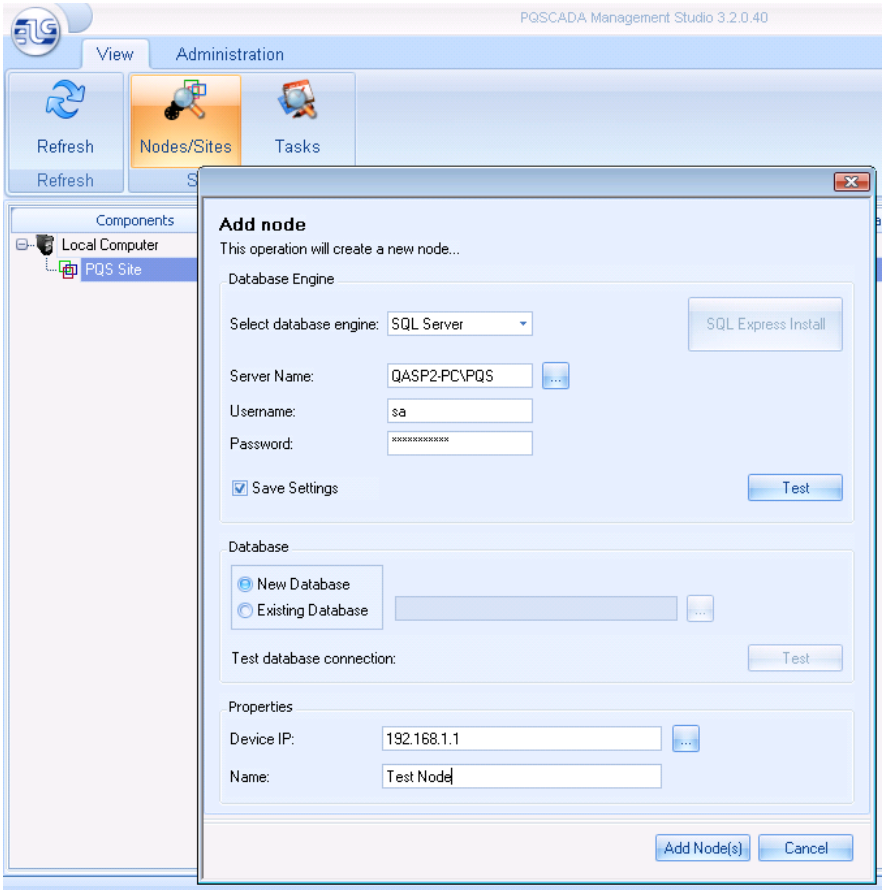
Adding a Node

A **Node** is a logical representation of the physical device location that performs all of the following functions:

- Retrieves and de-compresses the PQZip files
- Parses and stores the data into the correct database.
- Calculates queries in real time.

For each monitored device, a ***Node*** must be created.

To add a Node to the Site:



1. Right click **PQS Site**, then select **Add Node**.
2. From the **Add Node** window, Add a Node names **Test Node** to **PQS Site.**
3. Attach the device to the node using the default/assigned IP address (**192.168.1.1)** for this device.

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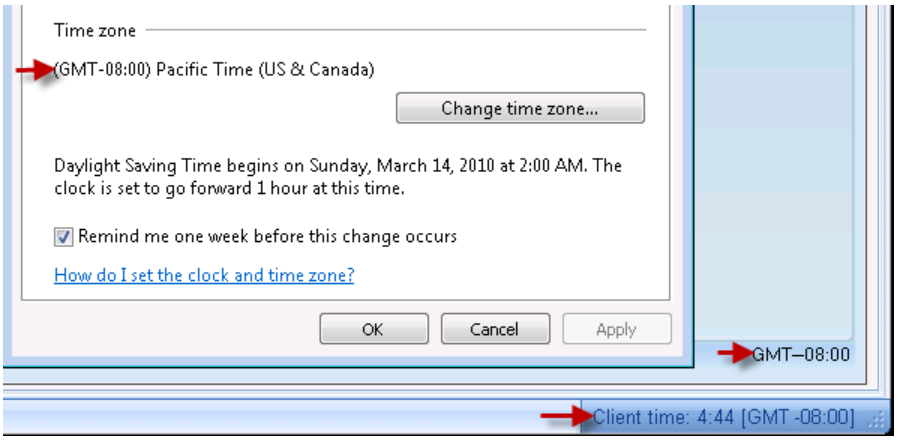
Verifying System Time Settings

The downloading and analyzing of data with the Software applications is time sensitive, therefore we strongly recommend that you verify that all time settings between your system, the PQSCADA, and Investigator are synchronized.

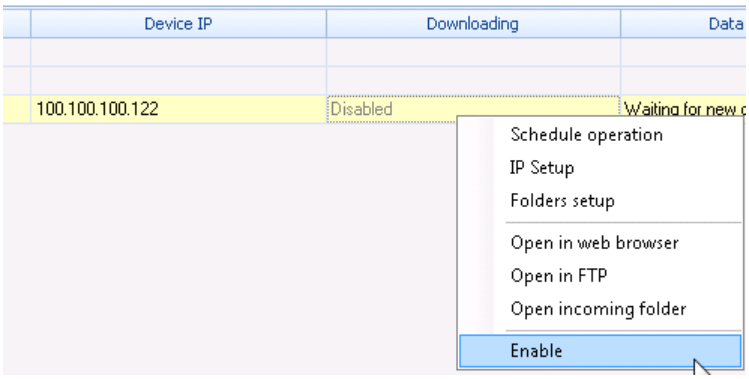
To verify system time settings:



- Verify the system time settings

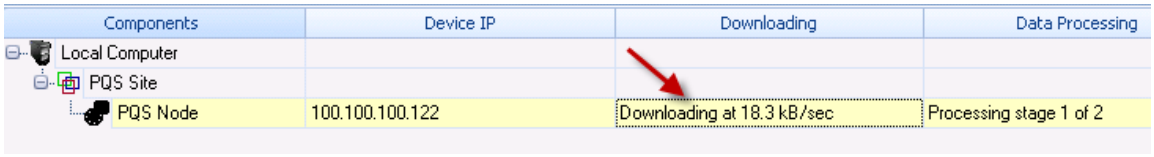
Enabling the Node

To enable the Node in PQSCADA:



- Right click the Node, then click **Enable.**

The PQSCADA is now downloading data from the device.



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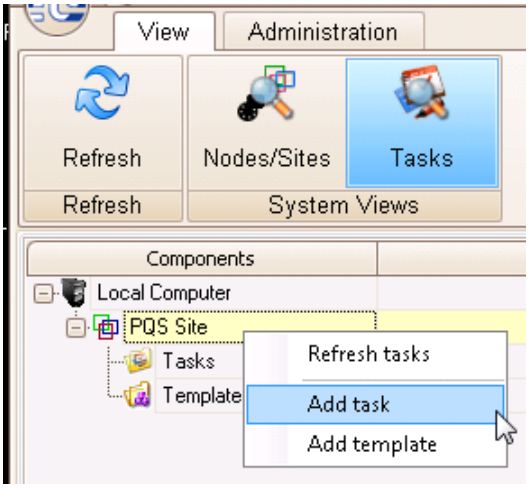
Data Export and Reporting

The PQSCADA allows you to set regularly scheduled exports and/or reports according to a specified event or time trigger (monthly, daily, weekly, and fixed) using the **Tasks** function.

With tasks you can:

- Export data in PQZIP, PQDIF, or Comtrade format
- Generate reports according to EN50160 and other National Standards
- Set automatic notifications

As with most PQSCADA components, you may access the ***Tasks*** through either the View or Administrative console. The default is View mode.



1. From the Tasks Tab, right click the Site, then select **Add Task**.
2. Follow the **Job Selection Wizard** to define the Task Configuration.

Templates

Templates are used to define the Events, Parameters, and Configurations for utilization by different tasks. By using templates, you can save the time of redefining all variables across multiple tasks. A single template can serve multiple tasks and a single task can have multiple templates.

- To define a template, simply follow the step-by-step **Template Wizard** instructions.

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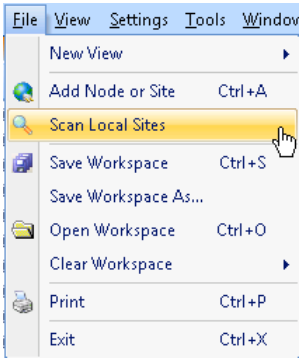
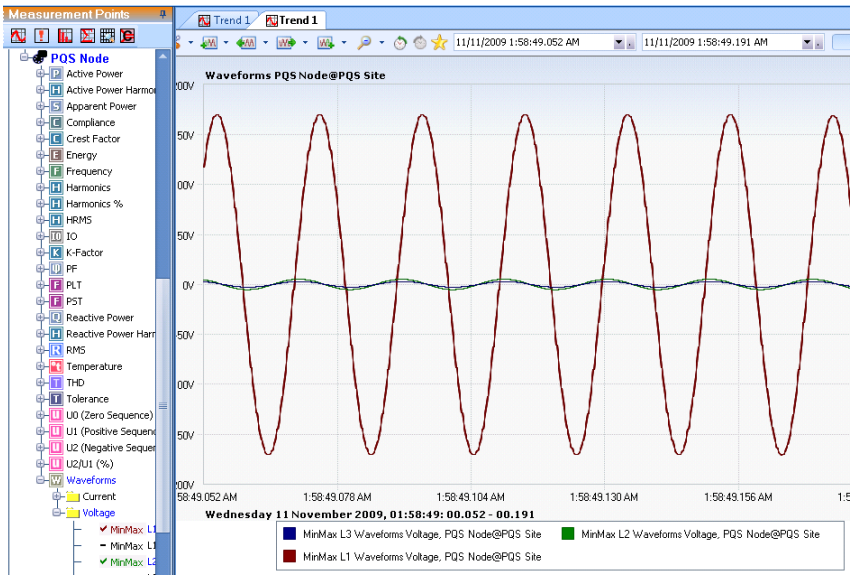
Viewing Downloaded Data with Investigator

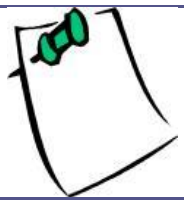
With the Elspec Power Quality Investigator, you can download, review and analyze data that has been organized by the Elspec PQSCADA. The Elspec Power Quality Investigator is an innovative tool which helps analyze electrical network anomalies while investigating power quality issues and eventually generate reports according to different PQ Standards such EN50160.

Adding a Node



- From the main menu, select **File→Scan Local Sites**, then view with Investigator.





Sometimes the application will take a few minutes to find the Site and Node, and for PQSCADA to start processing the data.

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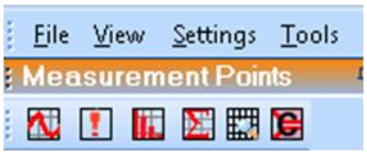
Views

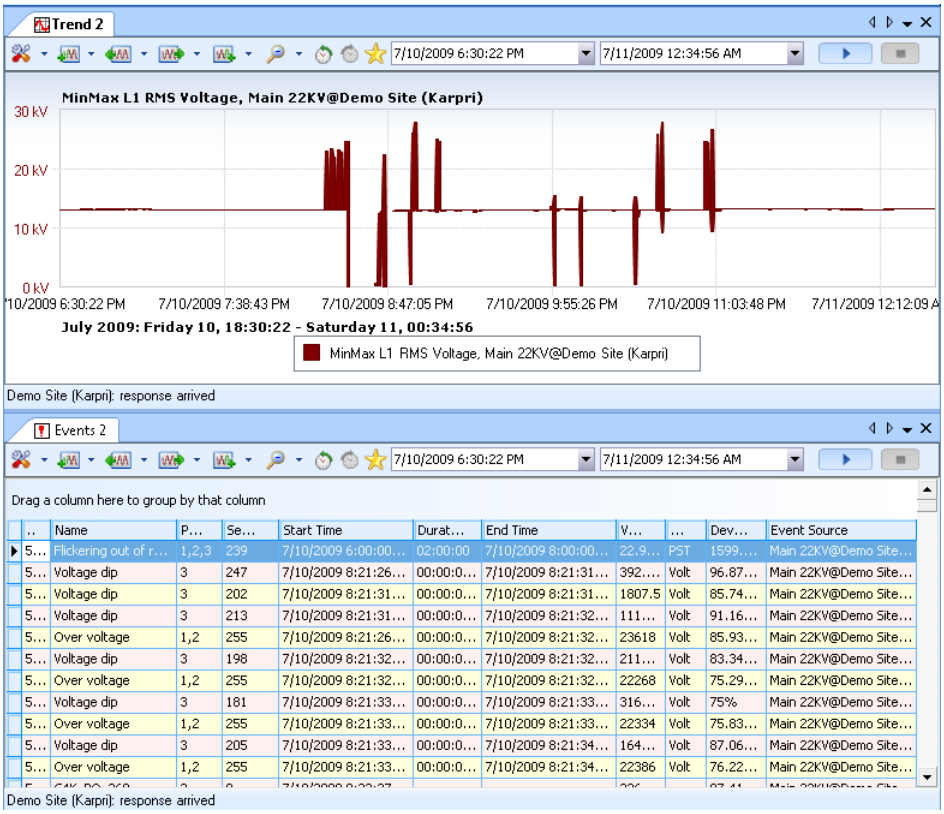


Icon	View Type
	Trend View
	Events View
	Spectrum View
	Summary View
	Trend Grid View
	CBEMA View

Multi-View

The Elspec Investigator is a multi-view application, which means that you can open and operate a number of views of any type simultaneously (Trend 2 and Events 2 in our example).

You may also view multiple devices simultaneously synchronized in time. This unique feature is useful to identify a common fault between multiple devices at different locations.



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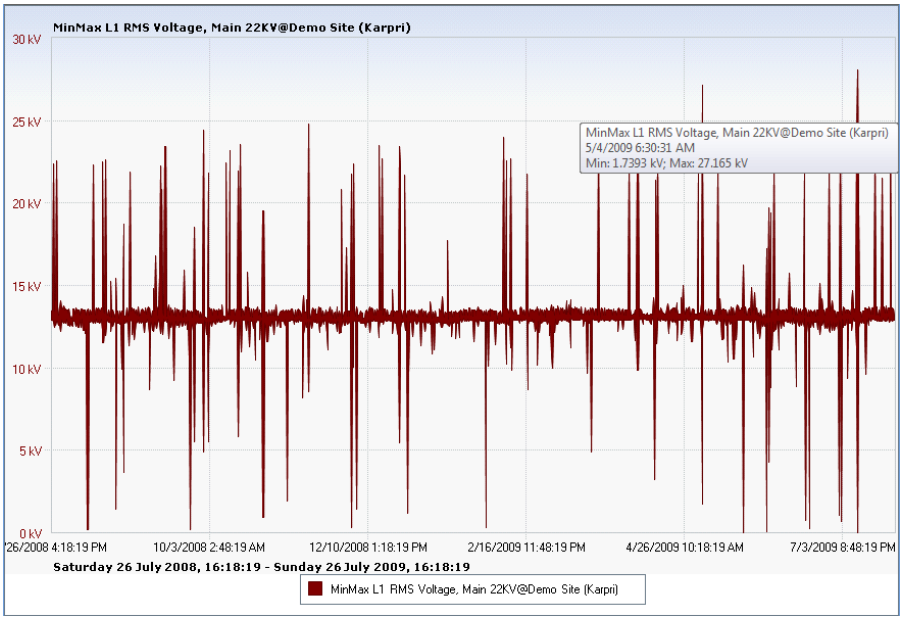
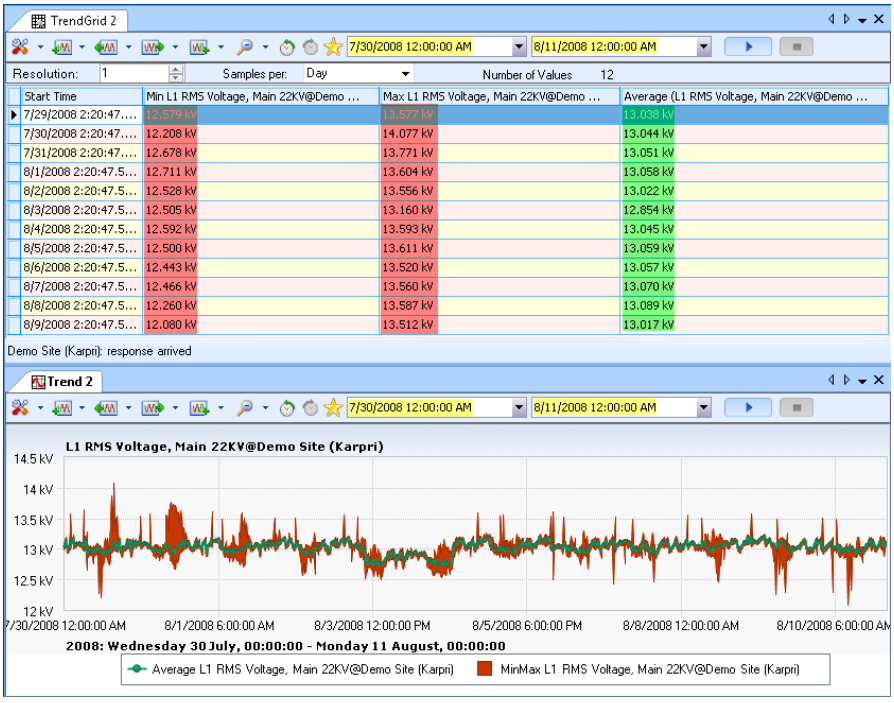
Trend View

A Trend view is a continuous trend graph of data parameters over time.



Trend Grid View

A trend grid view is simply a tabular representation of the trend view. Each measurement point in the table is plotted in graphical format in the **Trend View**



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Spectrum View

A spectrum view represents the harmonic spectrum over a period of time. In the graph below, we can clearly see the Harmonic Min/Max values for the given time period (one day). This is a unique feature because we are measuring harmonics for a given period of time, and the display shows the Min/Max values measured during the time period.

As you pass the mouse over a specific harmonic on the graph, a message box appears as above displaying all relevant information.

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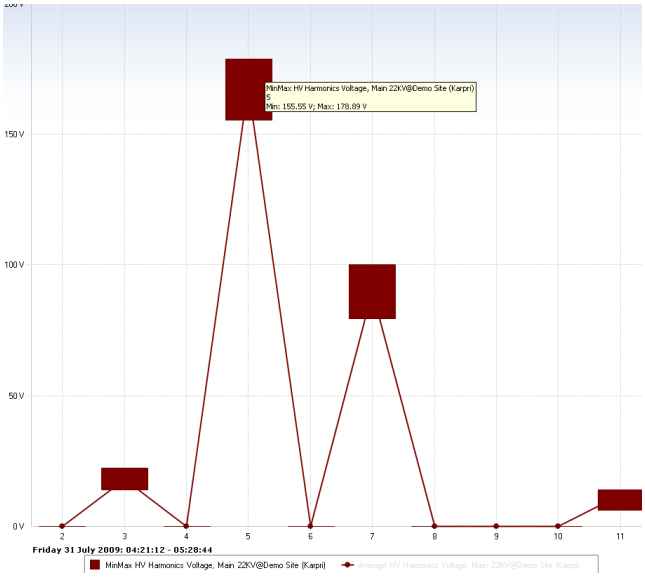
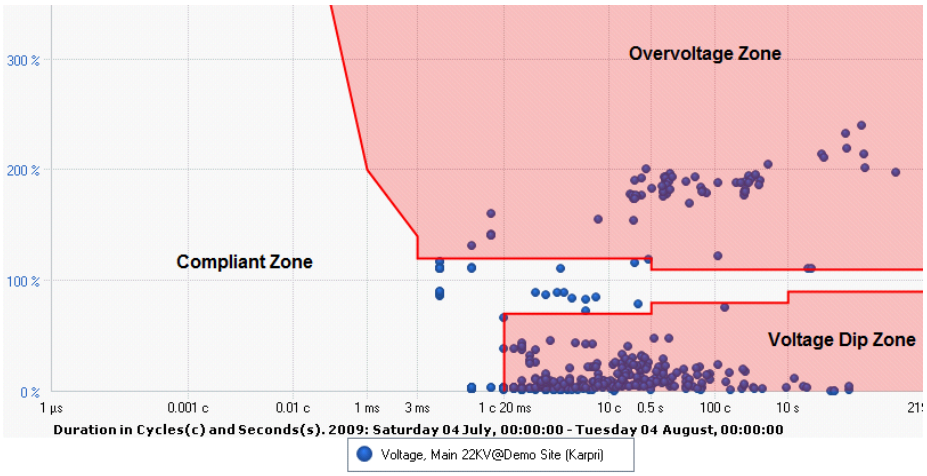
Viewing Minimum, Maximum and Average Values of a Voltage Harmonics

In order to utilize the functionality of the Spectrum View, it may be helpful to view both the Average and the MinMax views of the voltage under investigation.



CBEMA View

The CBEMA (Computer and Business Equipment Manufacturers' Association) is a power quality graph that plots the depth or deviation of voltage dips and overvoltage on the **x-axis** and the duration on the **y-axix.** Each event is plotted according to severity as defined by the CBEMA standard.



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Zooming In/Out

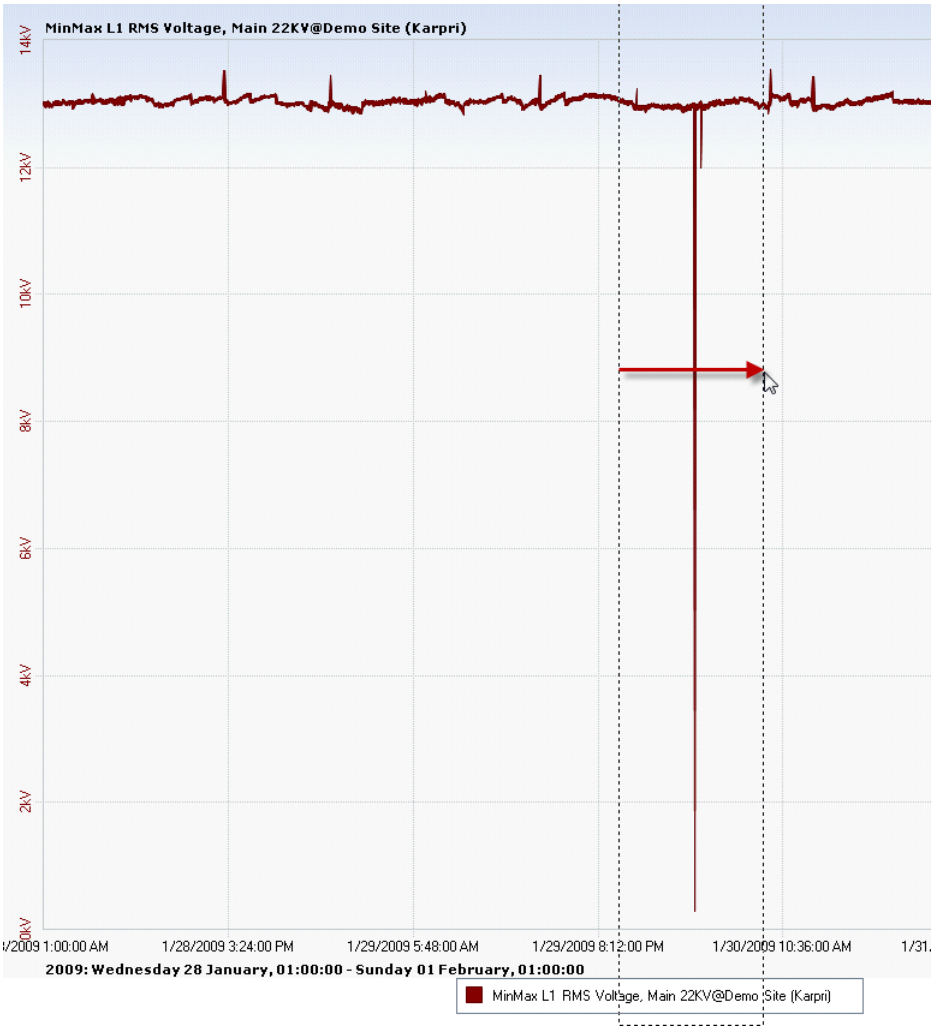
A very important feature of the Investigator application is the ability to drill in to a higher resolution around a specific point in time. With mouse click simplicity, you can drill down from a year to a millisecond. The higher the resolution, the more precise the graph you receive.

To Zoom In/Out

- From the graph, left click the mouse at the beginning of the desired zoom in period, drag the mouse across (dotted line region), then release at the end.

In the graph below, we are examining a voltage dip event that occurred around January 30, 2009. The zoom in feature allows us to zoom in to take a closer look at this event from a span of several days to microseconds as seen in the examples to follow.

From Days.....



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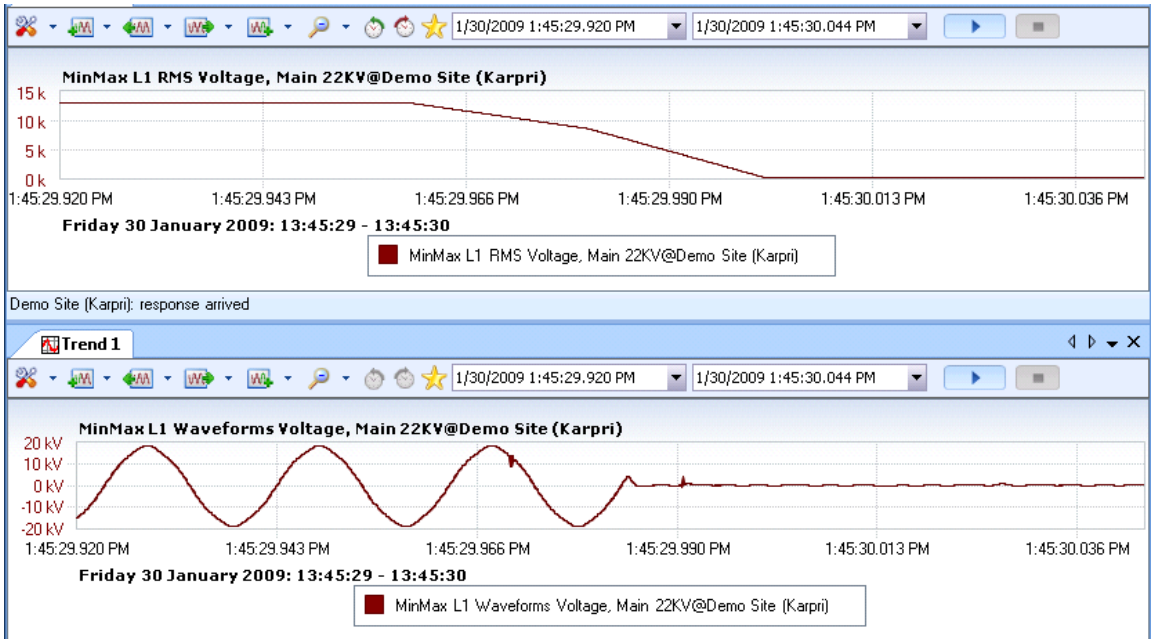
To Microseconds……..

The illustration below represents a zoom in to **microseconds** of a voltage drop event and the corresponding waveforms during the same time period.



Tools

Once a view is established, it is possible to change the view with the tool buttons at the top of the Main Viewing area.

Icon	Tool
	Toolbar
	Append Back
	Back
	Forward
	Append Forward
	Expand Time
	Previous Time
	Next Time Frame
	Favorites

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From the original Trend view as below of L1 Min/Max, the following screens will show how to change the views easily using these tools. Each view can be changed according to a pre-set time period.

Append Back

Appending back means that you leave the end time intact and move the start time back by a selected amount (five minutes in our example).

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Back

You may select **Back** to shift the current time duration back a specified amount of time (five minutes in our example).

Append Forward

Appending forward means that you leave the start time intact and move the end time forward by a selected amount (ten minutes in our example).

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Forward

You may select **Forward** to shift the current time duration forward a specified amount of time (three minutes in our example).

Expand Time

To expand or zoom out from a view, use the **Expand Time button**.

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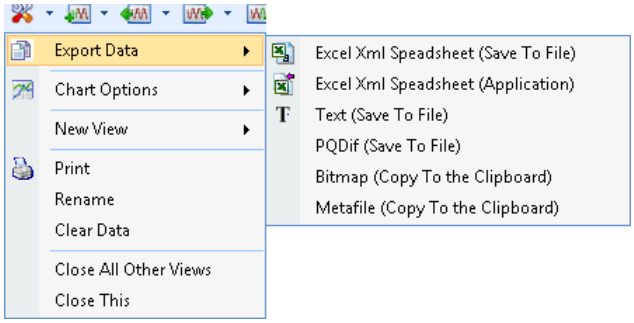
From here, it is possible to select the Zoom out ratio. Therefore an **X3 ratio** yields the three time larger interval as below

Previous Time/Next Time

In order to move back to the previous time selection, use the **Previous Time** button. To move in the opposite direction, use the **Next Time** frame button.

Trend Data Exporting

It is possible to export the graphic files in the following formats:



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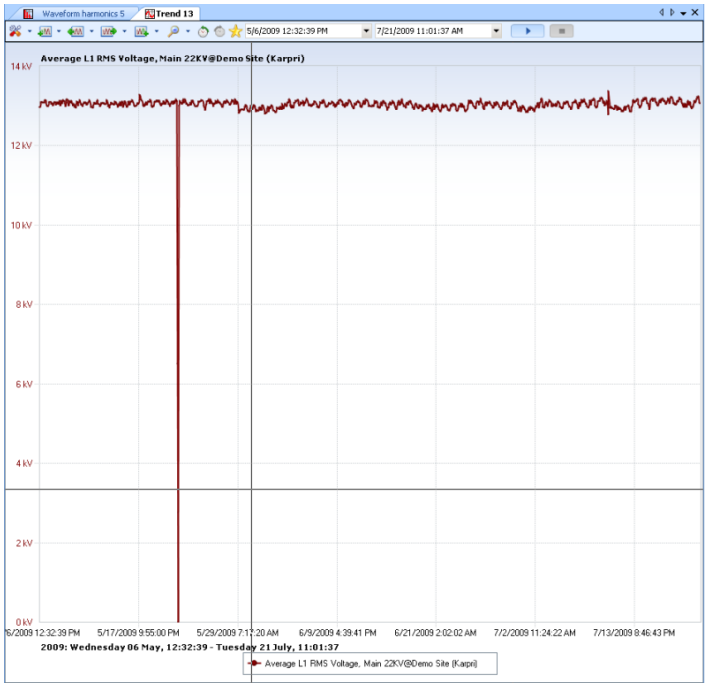
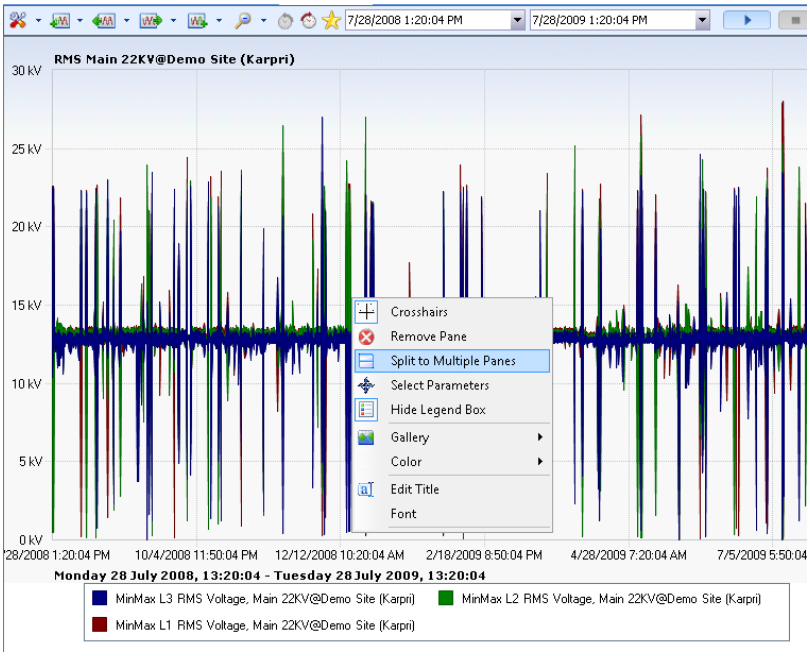
Crosshairs

This option allows you to more clearly identify an area of interest.



Multiple Panes

A graph can contain multiple parameters. In order to separate each in order to investigate further, it is sometimes easier to separate each parameter into its own pane.



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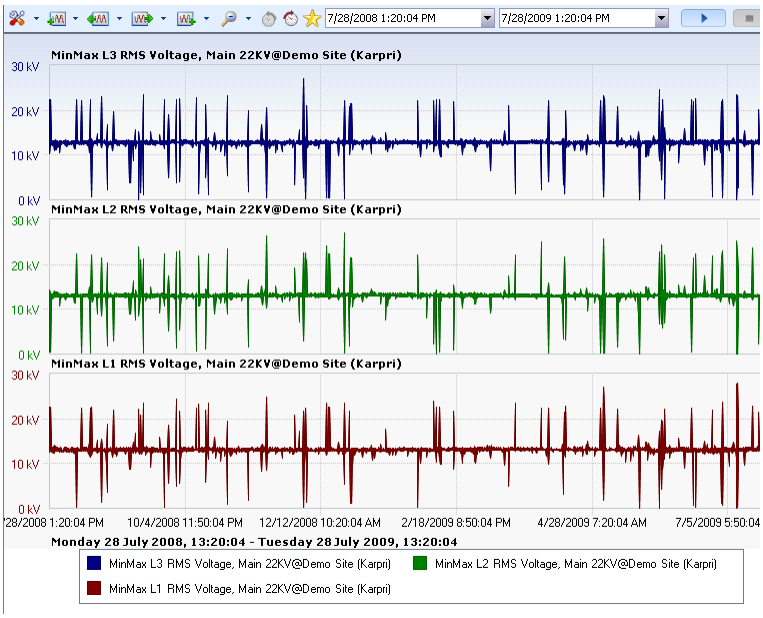
A new window is created splitting each parameter (L1, L2, and L3 into its own pane.



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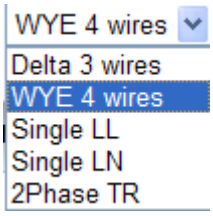
V Circuit Topologies

The BLACKBOX Portable provides 4 fast sampling AC/DC voltage inputs and an auxiliary DC voltage output (VDC). For measuring current, the Portable offers 4 AC and 1 AC/DC current measuring input socket. The current measuring input sockets actually measure Voltage at a low range therefore the risk of electrical shock is minimized.

The device is designed to serve in virtually any circuit topology configuration.

The pages to follow will show some of the most popular power topologies with suggested connection diagrams. The correct **Power Configuration** settings appear in parenthesis next to each configuration. The available choices from the **Configuration→Voltage & Frequency** section appear below.



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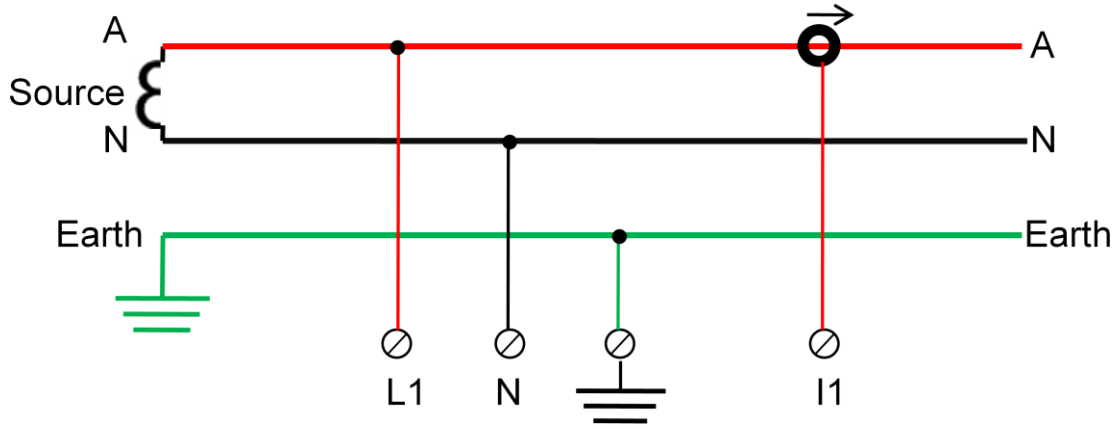
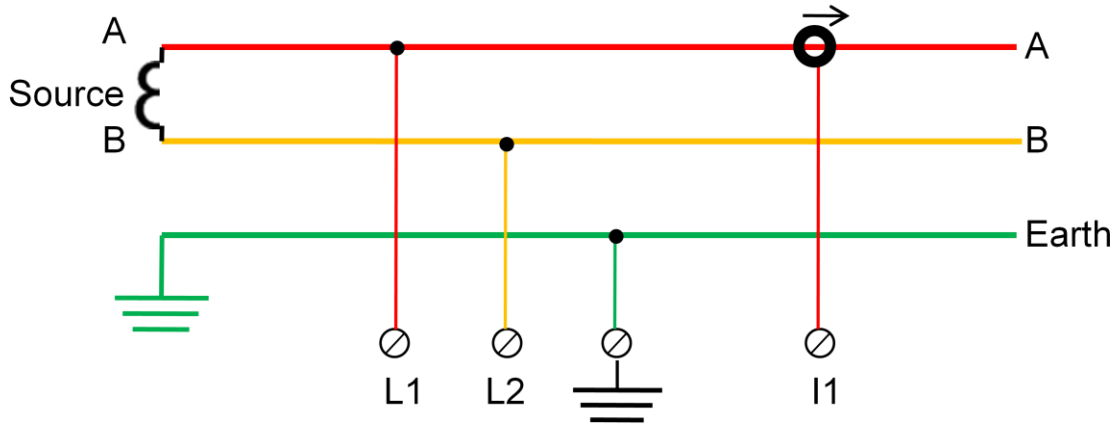
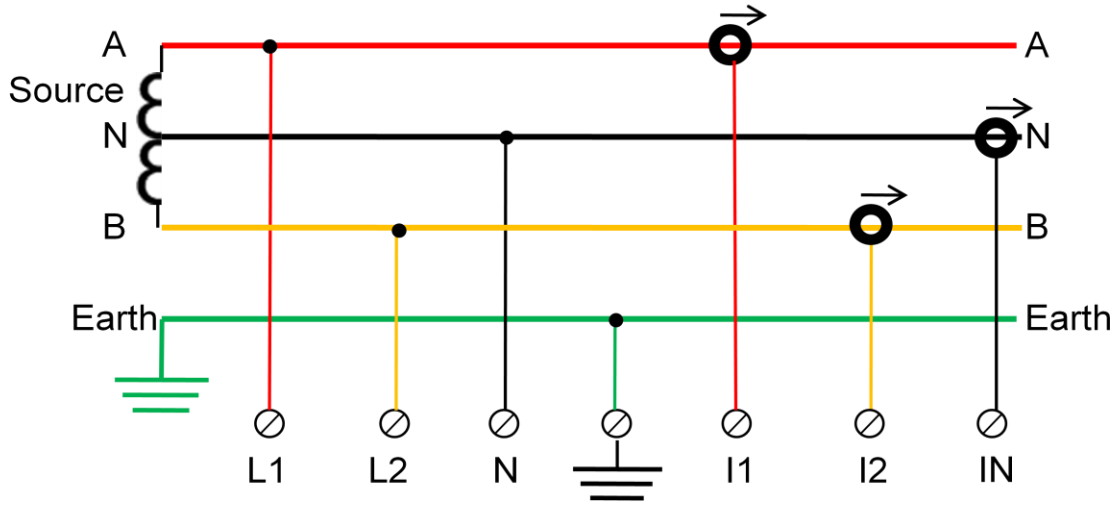
Single Phase with Neutral (Single LN)



Single Phase without Neutral (Single LL)



Single Split Phase (2Phase TR)



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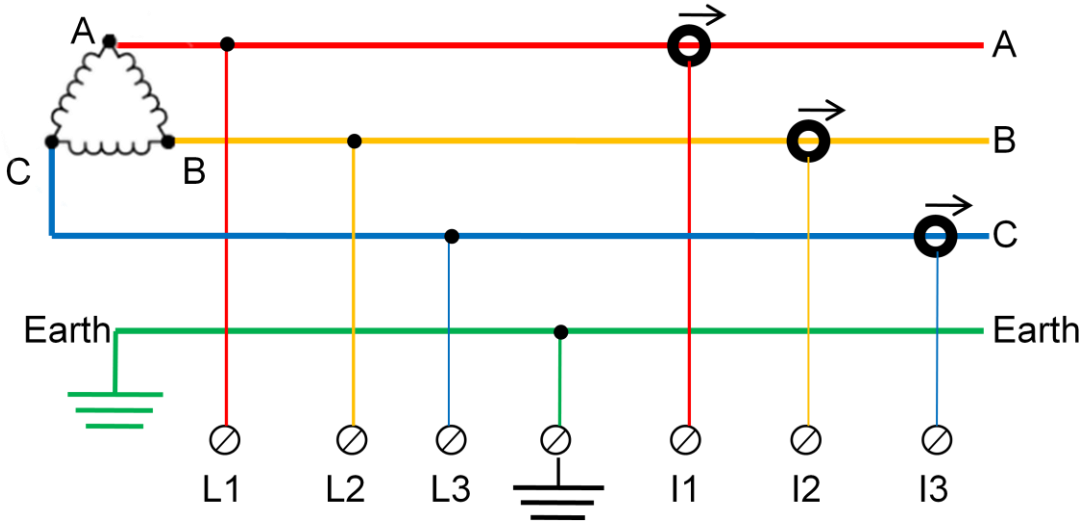
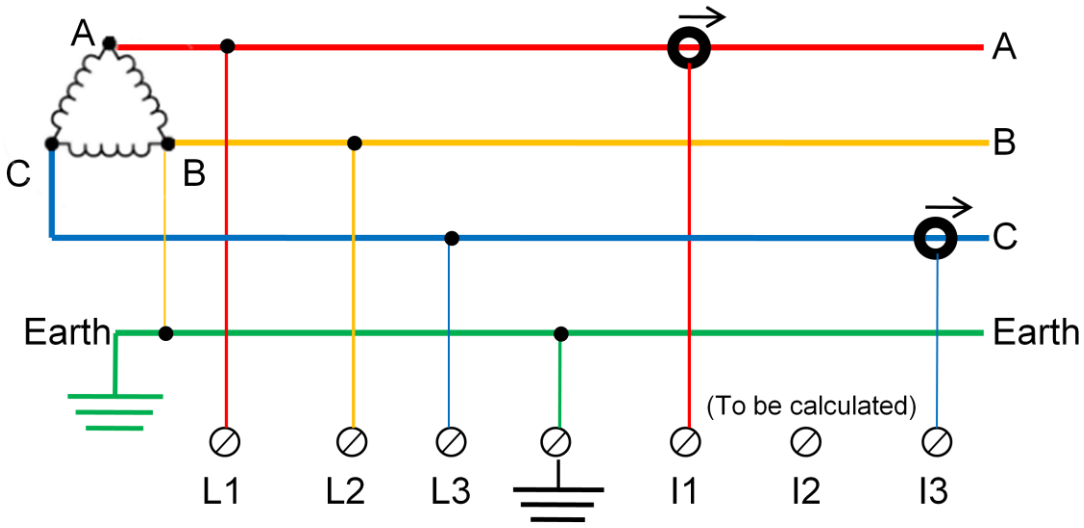
Three Wire Delta (Delta 3 Wire)



Grounded Delta (Delta 3 Wire)



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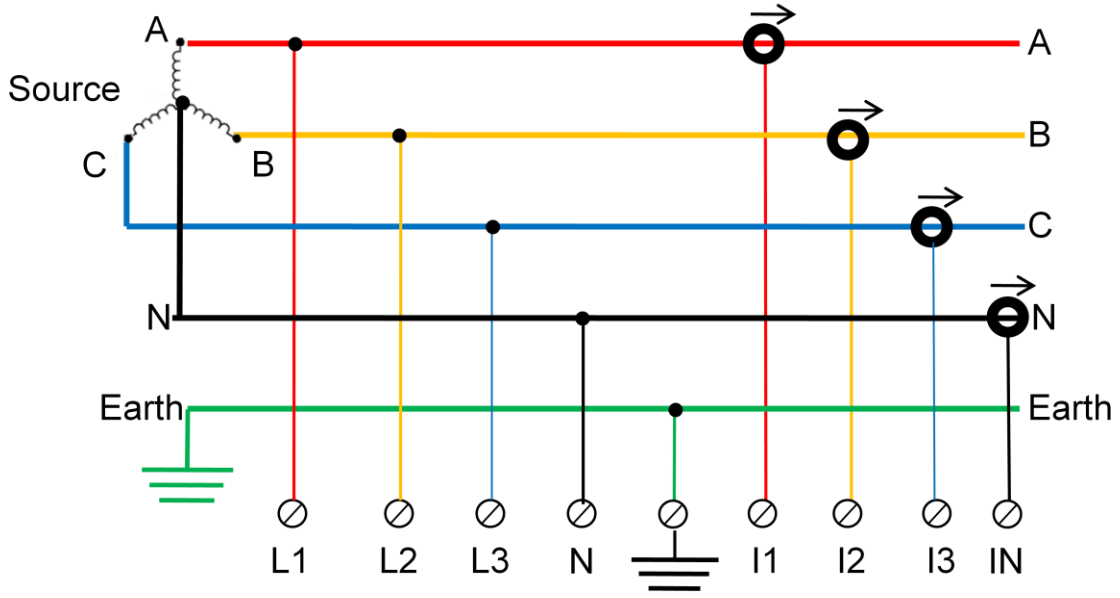
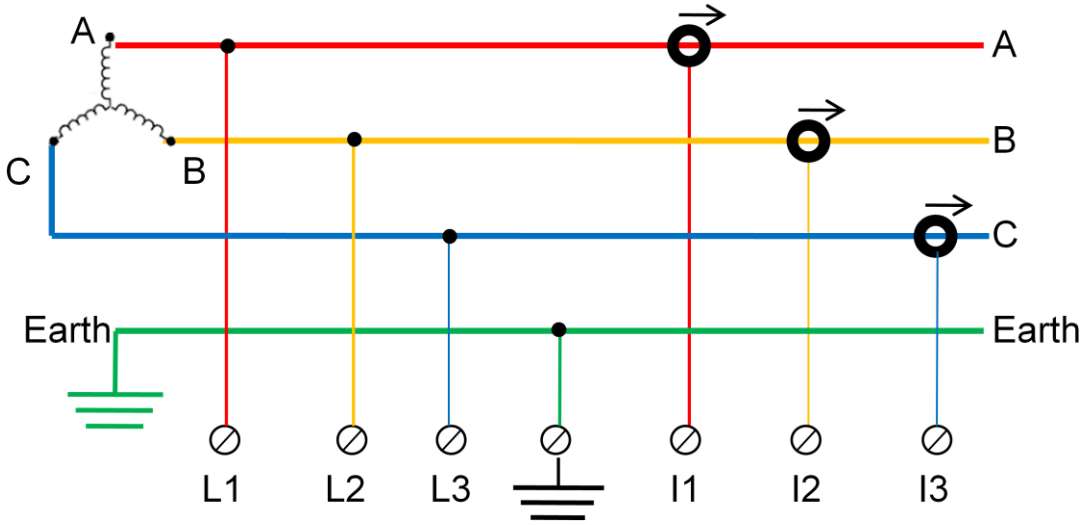
Four Wire WYE (WYE 4 Wire)



Three Wire WYE (Delta 3 Wire)



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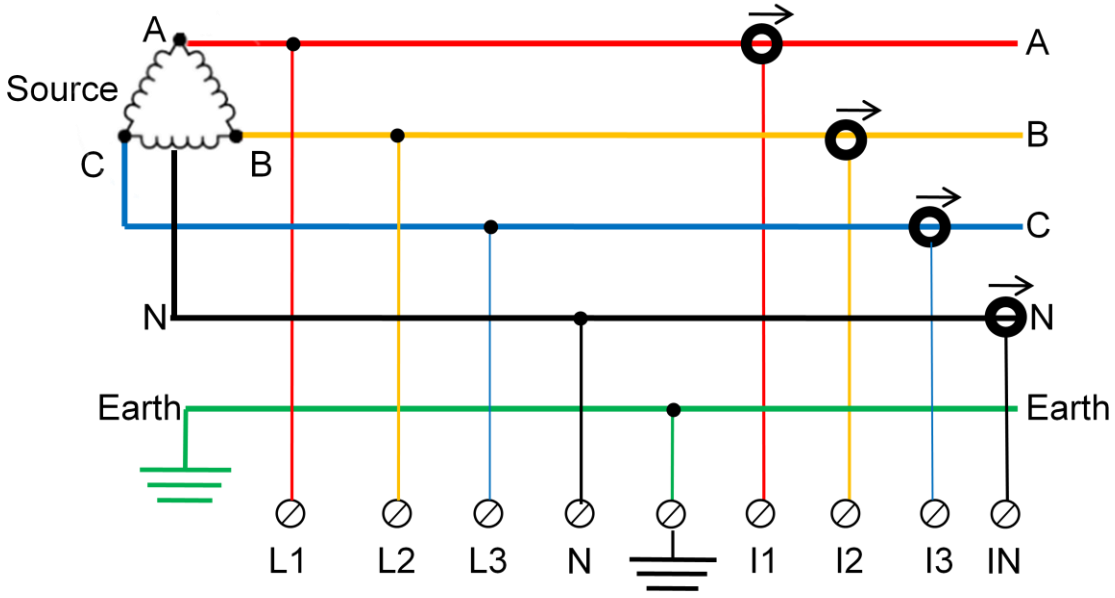
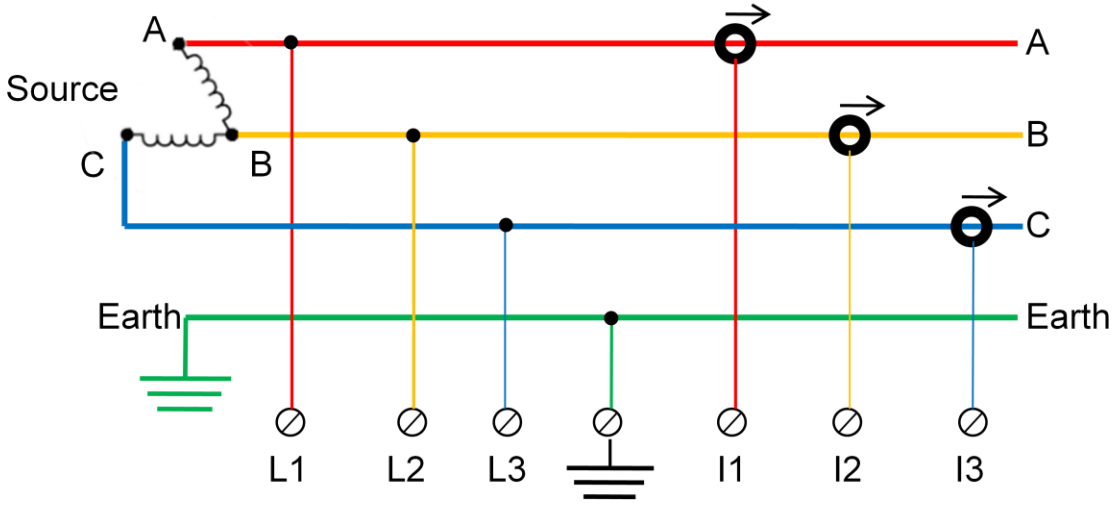
Delta High Leg (Delta 3 Wire)



Delta Open Leg (Delta 3 Wire)



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